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South Dakota Swine Field Day Proceedings and Research Reports, 1980

Animal Science Reports

1980

Twenty-fourth Annual Swine Day

Animal Science Department
South Dakota State University

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SDSU

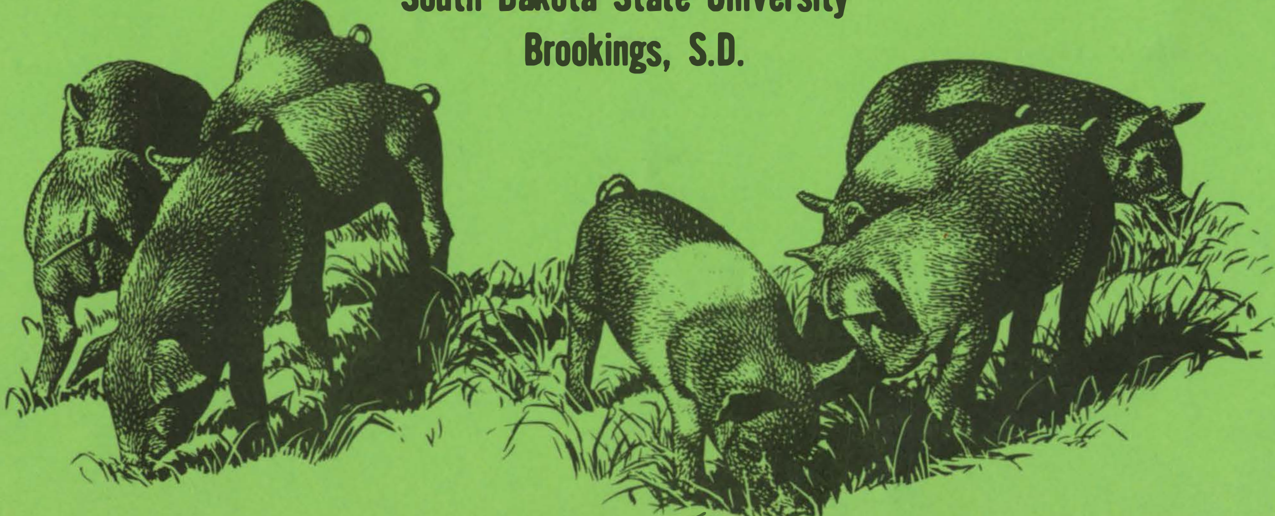
SWINE DAY

November 20, 1980

Animal Science Arena

South Dakota State University

Brookings, S.D.



'A SALUTE TO 14,000 S.D. SWINE PRODUCERS'

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1980
no. 24

PROGRAM

"A Salute to 14,000 South Dakota Swine Producers"

James Bailey, Chairman
Extension Veterinarian

Reducing Your Pork Production Cost -- L. J. Kortan, Extension Swine Specialist

Influence of Skeletal Size in Growth and Carcass Characteristics -- Dan Gee, Animal Science Department

My Observations of Factors Affecting Swine Productivity -- Linden Olson, Worthington, Minnesota

Pig Nursery Management Research -- George Libal, Animal Science Department

South Dakota Pork Council Report -- President Don Hoogestraat, Chancellor

Lunch

J. A. Minyard, Chairman
Head, Animal Science Department

Breeding and Reproductive Efficiency -- Dr. Dwane Zimmerman, Animal Science Department, University of Nebraska, Lincoln, Nebraska

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Effect of Antibiotic Feeding to 75 Pounds on Performance of Pigs Fed Different Antibiotics During the Growing-Finishing Period

SWINE DAY

Richard C. Wahlstrom and George W. Libal

SWINE 80-1

Antibiotics have been used as feed additives for the past 30 years. The greatest response in improved performance occurs during the early growth period, that is, from weaning to about 75 or 100 pounds. Several antibiotics have been approved as feed additives during recent years. It has been suggested that it may be beneficial to occasionally change antibiotics that are fed, although very little research has been conducted in this area.

The objectives of this study were to evaluate the use of antibiotics and antibiotic sequences for enhancing pig performance.

Experimental Procedure

Two groups of 36 pigs of an average weight of approximately 75 pounds were each allotted four pigs per pen to three treatments each replicated three times. One group of pigs had received the feed additive ASP-250 at a level of 250 grams per ton from weaning at 4 weeks to 75 pounds, while the other group was not fed antibiotics during this period. The pigs were housed in a completely enclosed building with fully slatted floors with feed and water provided *ad libitum*. Pens provided 8 square feet of space per pig.

The composition of the 14% crude protein corn-soybean meal supplemented diet is shown in table 1. The treatments were as follows:

Previous Treatment	Experimental Treatment
No antibiotic	1. No antibiotic
	2. 25 grams Tylan per ton
	3. 2 grams Flavomycin per ton
ASP-250 (250 g/ton)	1. No antibiotic
	2. 25 grams Tylan per ton
	3. 2 grams Flavomycin per ton

The experiment was terminated when the pigs reached an average weight of 215 pounds.

Results

A summary of the average daily gain and feed efficiency data are presented in tables 2 and 3, respectively. Data are presented to show the performance of pigs in the three treatment groups on the basis of previous antibiotic treatment in addition to the overall performance means.

TABLE 1. COMPOSITION OF EXPERIMENTAL DIET

Ingredient	Percent
Ground corn	82.0
Soybean meal, 44%	15.6
Dicalcium phosphate	1.2
Ground limestone	.7
Trace mineral salt	.3
Premix[a]	.2

[a] Supplied per lb. of diet: Vitamin A, 1500 IU; vitamin D, 150 IU; vitamin E, 2.5 IU; vitamin K, 1 mg; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 8 mg; choline, 25 mg; vitamin B_{12}, 5 mcg and selenium, .04 milligram.

TABLE 2. AVERAGE DAILY GAIN OF PIGS FED TYLAN AND FLAVOMYCIN DURING THE GROWING-FINISHING PERIOD[a]

	Growing-finishing treatments			
Previous treatment[b]	Control	Tylan	Flavo-mycin	Mean
		75-155 Pounds		
Control	1.59	1.55	1.57	1.57
ASP-250	1.43	1.60	1.48	1.50
Mean	1.51	1.58	1.53	
		155-215 Pounds		
Control	1.66	1.69	1.70	1.68
ASP-250	1.68	1.45	1.51	1.55
Mean	1.67	1.57	1.61	
		75-215 Pounds		
Control	1.62	1.60	1.60	1.61[c]
ASP-250	1.54	1.53	1.49	1.52
Mean	1.58	1.57	1.55	

[a] Three replicates of four pigs each per treatment.
[b] Average daily gain, weaning to 75 pounds, was .73 and .92 pound for pigs fed control and ASP-250, respectively.
[c] Significantly faster than pigs fed ASP-250 to 75 pounds ($P<.05$).

Effect of Antibiotic Feeding to 75 Pounds on Performance of Pigs Fed Different Antibiotics During the Growing-Finishing Period

Richard C. Wahlstrom and George W. Libal

SWINE 80-1

Antibiotics have been used as feed additives for the past 30 years. The greatest response in improved performance occurs during the early growth period, that is, from weaning to about 75 or 100 pounds. Several antibiotics have been approved as feed additives during recent years. It has been suggested that it may be beneficial to occasionally change antibiotics that are fed, although very little research has been conducted in this area.

The objectives of this study were to evaluate the use of antibiotics and antibiotic sequences for enhancing pig performance.

Experimental Procedure

Two groups of 36 pigs of an average weight of approximately 75 pounds were each allotted four pigs per pen to three treatments each replicated three times. One group of pigs had received the feed additive ASP-250 at a level of 250 grams per ton from weaning at 4 weeks to 75 pounds, while the other group was not fed antibiotics during this period. The pigs were housed in a completely enclosed building with fully slatted floors with feed and water provided *ad libitum*. Pens provided 8 square feet of space per pig.

The composition of the 14% crude protein corn-soybean meal supplemented diet is shown in table 1. The treatments were as follows:

Previous Treatment	Experimental Treatment
No antibiotic	1. No antibiotic
	2. 25 grams Tylan per ton
	3. 2 grams Flavomycin per ton
ASP-250 (250 g/ton)	1. No antibiotic
	2. 25 grams Tylan per ton
	3. 2 grams Flavomycin per ton

The experiment was terminated when the pigs reached an average weight of 215 pounds.

Results

A summary of the average daily gain and feed efficiency data are presented in tables 2 and 3, respectively. Data are presented to show the performance of pigs in the three treatment groups on the basis of previous antibiotic treatment in addition to the overall performance means.

TABLE 1. COMPOSITION OF EXPERIMENTAL DIET

Ingredient	Percent
Ground corn	82.0
Soybean meal, 44%	15.6
Dicalcium phosphate	1.2
Ground limestone	.7
Trace mineral salt	.3
Premix[a]	.2

[a] Supplied per lb. of diet: Vitamin A, 1500 IU; vitamin D, 150 IU; vitamin E, 2.5 IU; vitamin K, 1 mg; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 8 mg; choline, 25 mg; vitamin B_{12}, 5 mcg and selenium, .04 milligram.

TABLE 2. AVERAGE DAILY GAIN OF PIGS FED TYLAN AND FLAVOMYCIN DURING THE GROWING-FINISHING PERIOD[a]

Previous treatment[b]	Growing-finishing treatments: Control	Tylan	Flavomycin	Mean
	75-155 Pounds			
Control	1.59	1.55	1.57	1.57
ASP-250	1.43	1.60	1.48	1.50
Mean	1.51	1.58	1.53	
	155-215 Pounds			
Control	1.66	1.69	1.70	1.68
ASP-250	1.68	1.45	1.51	1.55
Mean	1.67	1.57	1.61	
	75-215 Pounds			
Control	1.62	1.60	1.60	1.61[c]
ASP-250	1.54	1.53	1.49	1.52
Mean	1.58	1.57	1.55	

[a] Three replicates of four pigs each per treatment.
[b] Average daily gain, weaning to 75 pounds, was .73 and .92 pound for pigs fed control and ASP-250, respectively.
[c] Significantly faster than pigs fed ASP-250 to 75 pounds (P<.05).

TABLE 3. FEED/GAIN OF PIGS FED TYLAN AND FLAVOMYCIN DURING THE GROWING-FINISHING PERIOD[a]

Previous treatment[b]	Growing-finishing treatments: Control	Tylan	Flavomycin	Mean
	75-155 Pounds			
Control	3.16	3.48	3.25	3.30
ASP-250	3.87	3.14	3.33	3.45
Mean	3.52	3.31	3.29	
	155-215 Pounds			
Control	3.60	3.57	3.73	3.63
ASP-250	3.81	3.61	3.70	3.71
Mean	3.71	3.59	3.72	
	75-215 Pounds			
Control	3.35	3.52	3.46	3.44
ASP-250	3.82	3.34	3.46	3.54
Mean	3.59	3.43	3.46	

[a] Three replicates of four pigs each per treatment.
[b] Feed/gain, weaning to 75 pounds, was 2.90 and 2.68 for pigs fed control and ASP-250, respectively.

Differences in average daily gains among treatments were small during all periods. From 75 to 155 pounds, the pigs fed Tylan or Flavomycin gained slightly faster than pigs that did not have an antibiotic in their diet. Gains were 1.51, 1.58 and 1.53 pounds per day for pigs fed the control, Tylan and Flavomycin diets, respectively. However, during the latter finishing period, 155 to 215 pounds, pigs fed the control diet gained faster than those fed either antibiotic so that for the overall period, 75 to 215 pounds, gains were similar among treatments. It is interesting to note that pigs that had not received antibiotics during the period prior to 75 pounds gained faster ($P<.05$) from 75 to 215 pounds than those pigs that received ASP-250 to a weight of 75 pounds. This increased gain was consistent in all three treatments. Since the average daily gain to 75 pounds was 26% faster when pigs were fed ASP-250, it is possible that the pigs that did not receive antibiotics to 75 pounds showed a compensatory performance during the growing-finishing period.

Feed per gain data, presented in table 3, show an overall improvement in feed efficiency of about 4% when antibiotics were included in the diet. Pigs fed ASP-250 prior to 75 pounds showed a considerable increase in feed required per pound of gain when fed the diet without antibiotic from 75 to 215 pounds. As was true for average daily gains, less feed/gain was required by pigs that were fed the control diet to 75 pounds compared to pigs fed diets containing ASP-250 during that time.

Summary

Seventy-two pigs, averaging 75 pounds initially, were used in an experiment to evaluate the effect of feeding the antibiotics Tylan and Flavomycin in growing-finishing diets at levels of 25 and 2 grams per ton, respectively.

Feeding diets containing either of these antibiotics to pigs from 75 to 215 pounds live weight did not affect the rate of gain but did result in about 4% improvement in feed/gain. Performance was slightly better during the 75- to 215-pound period if pigs had not received antibiotics from weaning to 75 pounds. Daily gains were increased 6% and feed/gain approximately 3%.

Basic H as a Feed Additive

George W. Libal and Richard C. Wahlstrom

SWINE 80-2

Swine producers are always looking for a way to lower feed costs which represent the largest expenditure in a swine production unit. We have been informed that some producers are reducing supplemental dietary protein and adding Shaklee's Basic H or Basic H plus Shaklee's Nutritional Protein Supplement (NPS), a human protein supplement. Although these products are not recommended or approved as feed additives, some producers are convinced that their pigs perform adequately when this has been done. The experiment reported herein was conducted to evaluate, under controlled conditions, this practice of reducing protein requirements by adding these products to the diet.

Experimental Procedure

Sixty crossbred pigs were allotted at an average weight of approximately 49 pounds to five experimental diets replicated three times. Each pen contained two barrows and two gilts. The pigs were housed on totally slatted concrete floors in our environment-modified finishing house. Eight square feet of floor space was provided for each animal and adequate feeder and waterer space was provided. The trial lasted 7 weeks at which time the average weight of the pigs was approximately 112 pounds.

The experimental diets are shown in table 1. These consisted of a 16% protein diet, two diets which contained 14% protein and two diets which contained 12% protein. The 14% and 12% protein diets represented soybean meal reductions of 100 pounds and 200 pounds, respectively. One of each of the 12 and 14% protein diets was supplemented with one quart of Basic H and one can of NPS.

TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS

Protein, %	16	14	14	12	12
Ground yellow corn	1500	1600	1600	1700	1700
Soybean meal, 44%	400	300	300	200	200
Dicalcium phosphate	22	24	24	26	26
Limestone	18	18	18	17	17
Trace mineralized salt (.8% zinc)	10	10	10	10	10
Vitamin-antibiotic premix[a]	50	48	47	47	46
Shaklee's Basic H (1 quart)			+		+
Shaklee's NPS (1 can)			1		1
	2000	2000	2000	2000	2000

[a] Concentration of the premix varied to provide 50 grams per ton aureomycin and the recommended levels of vitamins to each diet.

Results

A summary of pig growth and efficiency is shown in table 2. As might be expected, pigs grown from approximately 49 pounds to 112 pounds average weight gained at a slower rate as the protein content of the diet was reduced from 16% to 14% and finally to 12% (1.47, 1.34 and 1.16 pounds per day, respectively). Daily feed consumption, on the average, was reduced in the same manner to 4.36, 4.22 and 4.08 pounds per day as the protein level was reduced. Progressively more feed was required per unit of gain with decreasing levels of protein (2.99, 3.18 and 3.51). Additions of Basic H and NPS to the 14% and 12% diets failed to improve rate of gain or efficiency of gain to equal the performance of pigs fed higher protein levels. In this study, pigs receiving 12% protein diets with the Shaklee supplements did gain faster than those fed the unsupplemented 12% protein diet but did not gain at the rate of pigs fed the 14% protein diet. It should be pointed out that decreasing a complete commercial supplement by the levels that soybean meal was reduced in this study would most likely cause even greater depression of performance because of deficiencies of minerals and vitamins as well as protein.

TABLE 2. PERFORMANCE OF PIGS FED DIETS OF VARYING PROTEIN CONTENT AND WITH OR WITHOUT SHAKLEE PRODUCTS[a]

Protein, %	16	14	14	12	12
Basic H + NPS[b]	-	-	+	-	+
Starting weight, lb	49.0	49.1	49.1	48.5	49.0
Ending weight, lb	120.9	114.4	114.9	101.8	109.5
Average daily gain, lb	1.47	1.33	1.34	1.09	1.23
Average daily feed, lb	4.36	4.16	4.28	3.86	4.30
Feed/gain	2.99	3.13	3.23	3.56	3.47

[a] Results are from a 49-day trial with each mean representing results from three pens of four pigs, a total of 60 pigs in the trial.
[b] Additions of Shaklee's Basic H (1 quart per ton) and Shaklee's Nutritional Protein Supplement (1 can per ton) were made where indicated.

Summary

Sixty crossbred pigs were fed from 49 to 112 pounds to evaluate the effects of reducing protein in the growing pig's diet and supplementing those lower protein diets with Shaklee's Basic H and NPS. As protein levels decreased from 16% to 14% and 12%, average daily gain, average daily feed and efficiency of gain were reduced. Supplementation with the Shaklee product was of no benefit. These results obtained under controlled conditions would indicate there is no rationale for the addition of these products as a substitution for supplementary protein.

The Effect of an Organic Iron Compound on Conception Rate in Gilts

Richard C. Wahlstrom and George W. Libal

SWINE 80-3

Iron is an essential mineral element for swine. Supplemental iron is added to most swine diets to insure adequate levels of this mineral for optimum production. Research has shown that amino acid-iron chelates in the diet increase the level of iron in the milk but not sufficiently to meet the pigs' iron needs. Other reports, unconfirmed in the literature, have indicated certain iron products can improve conception rate in gilts.

The objective of this study was to study the effect of an organic iron, containing mostly iron choline citrate and ferrous fumerate as iron sources, when added to swine diets from 30 days before breeding to the time gilts were slaughtered, approximately 35 days post-breeding.

Experimental Procedure

Forty-four crossbred gilts were allotted into two groups at approximately 8 months of age. Group 1 received the control diet and group 2 received this diet plus 5 pounds of the iron supplement "Swinacol" per ton of feed. This level of supplementation added 187.5 ppm of iron to the control diet. The trace mineralized salt also supplied 16.5 ppm of elemental iron to the control diet. Diets were fed at the rate of 5 pounds per day. The composition of the diet is shown in table 1.

TABLE 1. COMPOSITION OF CONTROL DIET (%)

Ingredient	Percent
Ground corn	77.5
Alfalfa meal	10.0
Soybean meal, 44%	9.0
Dicalcium phosphate	2.3
Limestone	.5
Trace mineral salt[a]	.5
Vitamin premix[b]	.2

[a] Contains .8% zinc.
[b] Supplied per pound of diet: vitamin A, 2000 IU; vitamin D, 200 IU; vitamin E, 2.5 mg; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 8 mg; choline, 25 mg and vitamin B_{12}, 5 micrograms.

These diets were fed for 30 days prior to the start of the breeding season which was for a 21-day period. Gilts were heat checked each day and gilts that were in heat were bred and left with the boar for 24 hours. They remained on the respective treatments until slaughtered at between 29 and 49 days (average 35 days) post-breeding. Reproductive tracts were removed and the ovaries were examined to determine the number of corpora lutea and the number of embryos present in the uterus were counted.

Results

A summary of the reproductive performance as measured by conception rate, corpora lutea and live embryos at approximately 35 days is shown in table 2.

TABLE 2. EFFECT OF ORGANIC IRON (SWINACOL) ON CONCEPTION RATE, OVULATION AND EMBRYO SURVIVAL

Parameter	Control	Swinacol
No. gilts bred	22	22
No. gilts conceived	16	12
Percent gilts conceived	72.7	54.5
Avg number of corpora lutea	13.0	13.7
Avg number of embryos (35 days)	10.5	10.9
Embryos/CL, %	80.8	79.9

Sixteen of the 22 control gilts were pregnant compared to only 12 of 22 gilts that received Swinacol. Percentage conception was 72.7% for the control group and 54.5% for the iron treatment. Since this is a relatively small number of animals per treatment (22), it is not suggested that the iron treatment was detrimental. However, one can assume that the organic iron was of no benefit in increasing conception rate of gilts. Number of CL and embryos per gilt were quite similar but favored the gilts receiving the supplemental iron. However, embryos as a percent of CL were 79.9% for gilts receiving Swinacol and 80.8% for the control gilts.

Summary

Forty-four gilts about 8 months in age were divided into two groups. One group received the control diet for 30 days prebreeding and about 35 days post-breeding, while group 2 was fed the same diet plus 5 pounds of an organic iron product ("Swinacol") per ton of feed. There were no significant differences in conception rate, numbers of CL or embryos at approximately 35 days post-breeding between the two groups.

The Effect of Dietary Protein Deficiency During Early Growth on Subsequent Performance of Growing-Finishing Swine

Richard C. Wahlstrom and George W. Libal

SWINE 80-4

Recommendations for dietary protein requirements of swine are based on the amount of protein needed to provide for maximum production. As the pig grows and matures, the dietary needs of protein decrease when expressed as a percentage of the diet. Previous research at this station had shown that feeding a deficient diet during early growth reduced gains and increased feed required per unit of gain. However, if the deficient diet was followed by a diet adequate in nutrients, pigs grew at a faster and more efficient rate, thus "compensating" for the earlier poor performance.

The objective of this experiment was to determine the effect of short periods of protein deficiency on pigs of different initial weights and the performance of these pigs during subsequent growth when diets of adequate protein were fed.

Experimental Procedure

Ninety-six pigs were allotted from three outcome groups having initial weights of 40, 50 or 60 pounds to two dietary protein levels. Four replicated lots containing four pigs per lot were assigned to each of the six treatments. The pigs were housed in open-front, uninsulated wooden houses (8 x 12 feet) that were divided in the center so inside pens were 6 x 8 feet. Each pen had an outside concrete area (6 x 12 feet) where feeders and waterers were located.

The treatments were as follows:

		Dietary protein	
Treatment	Initial wt., lb	0-4 weeks	4 weeks to 220 lb
1	40	14	14
2	50	14	14
3	60	14	14
4	40	16	14
5	50	16	14
6	60	16	14

The National Research Council lists the protein requirement for 44- to 77-pound pigs to be 16% and for pigs from 77 to 132 pounds as 14%. Therefore, the 16% protein diet fed during the first 4 weeks may have been slightly deficient in protein at the start of the experiment for those pigs of an initial weight of 40 pounds but adequate for the 50- and 60-pound pigs. Composition of the two diets used in this experiment is shown in table 1. Barrows were slaughtered at about 220 pounds to obtain information on carcass length, backfat, loin eye area and percent lean.

TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS (%)

Ingredient	Protein level 14%	16%
Corn	82.2	76.5
Soybean meal, 44%	15.0	20.7
Dicalcium phosphate	1.2	1.2
Limestone	.9	.9
Trace mineralized salt	.5	.5
Vitamin premix[a]	.2	.2

[a] Supplied per pound of diet: vitamin A, 1500 IU; vitamin D, 150 IU; vitamin E, 2.5 IU; vitamin K, 1 mg; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 8 mg; choline, 25 mg; vitamin B_{12}, 5 mcg; selenium, 45 mcg and aureomycin, 25 milligrams.

Results

Average daily gain and feed/gain data by periods and for the entire trial are presented in table 2. Protein deficiency during the initial 4-week feeding period resulted in significantly slower daily gains and more feed/gain for pigs fed 14% protein diets compared to those fed 16% protein diets. Rate of gain increased as initial weight increased when pigs were fed 14% protein diets. Pigs fed the 16% protein diet with an initial weight of 50 or 60 pounds gained considerably faster during this 4-week period than the 40-pound pigs fed the same diet.

TABLE 2. AVERAGE DAILY GAIN AND FEED/GAIN[a]

Protein, 0-4 weeks (%)	14	14	14	16	16	16
Protein, 4 weeks-220 lb (%)	14	14	14	14	14	14
Initial weight (lb)	40	50	60	40	50	60
Avg daily gain by period, lb						
0-4 weeks[bc]	1.10	1.32	1.50	1.39	1.72	1.74
4 weeks-220 lb[b]	1.68	1.76	1.92	1.70	1.68	1.79
Initial to 220 lb[b]	1.54	1.65	1.76	1.63	1.70	1.76
Feed/gain by period						
0-4 weeks[bc]	2.89	3.16	3.11	2.55	2.33	2.64
4 weeks-220 lb[b]	3.80	3.67	3.42	3.65	3.86	3.54
Initial to 220 lb[b]	3.65	3.56	3.33	3.41	3.46	3.31

[a] Four replicates of four pigs each per treatment.
[b] Significant difference (P<.05) due to initial weight.
[c] Significant difference (P<.01) due to protein level.

Compensatory performance occurred during the finishing period with pigs that had an initial weight of 50 or 60 pounds, but the lighter pigs of 40-pound initial weight did not exhibit any compensatory performance during the finishing period when all pigs were fed the 14% protein diet. Pigs weighing 50 pounds initially, that had been fed the 14% protein diet to 4 weeks, gained 1.76 pounds per day from 4 weeks to 220 pounds compared to 1.68 pounds daily for pigs fed the 16% protein diet to 4 weeks. The pigs of 60 pounds initial weight and fed 14% dietary protein the first 4 weeks gained about 7.5% faster (1.92 vs 1.79 pounds per day) from 4 weeks to 220 pounds than those fed the 16% protein diet the first 4 weeks. Likewise, feed efficiency during the finishing period (4 weeks to 220 pounds) was improved when 14% protein diets were fed for 4 weeks to 50- or 60-pound pigs.

Overall growth performance, gain and feed/gain were similar for 60-pound pigs fed either the 14-14 or 16-14% protein dietary sequence. The low protein diet (14% protein) had a more detrimental overall effect on the lighter weight pigs and a smaller effect on the middle weight (50 pounds) pigs.

There were no significant differences in carcass characteristics of barrows slaughtered at 220 pounds. Carcass length, backfat, loin eye area and percent lean are shown in table 3.

TABLE 3. EFFECTS OF DIETARY TREATMENT ON CARCASS CHARACTERISTICS

Protein, 0-4 weeks (%)	14	14	14	16	16	16
Protein, 4 weeks-220 lb (%)	14	14	14	14	14	14
Initial weight (lb)	40	50	60	40	50	60
Number of pigs	8	8	8	8	5	8
Carcass length, in.	30.7	30.9	31.1	31.2	31.6	31.5
Avg backfat, in.	1.38	1.53	1.42	1.23	1.47	1.38
Avg tenth rib fat, in.	1.18	1.41	1.29	1.21	1.38	1.36
Loin eye area, sq. in.	5.05	5.18	5.19	5.26	5.36	4.98
Percent lean	53.4	52.2	53.0	53.8	52.7	52.1

Summary

Ninety-six pigs having initial weights of approximately 40, 50 and 60 pounds were used to study compensatory performance following a 4-week period of dietary protein deficiency. Pigs of the three weight groups were fed 14 or 16% protein diets for 4 weeks and all received the 14% diet from 4 weeks to 220 pounds.

Pigs of an initial weight of 50 or 60 pounds that were fed protein deficient diets during early growth compensated for decreases in gain and feed/gain during the subsequent finishing period. The results indicated that pigs of an initial weight of 60 pounds could be fed one diet of 14% protein throughout the growing-finishing period without detrimental effect on gain, feed/gain or carcass characteristics.

'Zinpro-40' Additions to Pig Starter Diets

George W. Libal and Richard C. Wahlstrom

SWINE 80-5

Previous research at this station (A.S. Series 74-27) had found "Zinpro-40," a zinc proteinate, to be ineffective in improving performance of growing-finishing pigs. It has been suggested that a response to the compound might be obtained with younger pigs in a stress condition after weaning.

The objective of this study was to determine the effect of "Zinpro-40" in diets of pigs mixed from two sources as well as housed in open-front houses during October and November.

Experimental Procedure

Ninety-six pigs averaging approximately 22 pounds were used in the study which compared an 18% protein basal diet (table 1) containing 25 ppm of added zinc with the same diet plus 2 pounds of "Zinpro-40" per ton. "Zinpro-40" contained 9% zinc and thus added an additional 90 ppm of zinc to this diet. The pigs were mixed from two sources (SDSU pigs and pigs from a commercial feeder pig producer) on the day they were allotted to the two treatments. The pigs from the two sources were grouped in six weight groups of 16 pigs each. They were then allotted to two pens receiving the two diets on the basis of sex, source and weight from within the groups of 16 pigs. The allotment resulted in two pens in each weight group with equal numbers of pigs from each source, from each sex and with the same average weight. The trial lasted 33 days.

TABLE 1. COMPOSITION OF EXPERIMENTAL DIET (%)

Ingredient	Control diet
Ground yellow corn	70.50
Soybean meal, 44%	26.50
Dicalcium phosphate	1.15
Limestone	1.10
Trace mineral salt[a]	.30
Vitamin-antibiotic premix[b]	.45

[a] Contains .8% zinc.
[b] Supplied per pound of diet: vitamin A, 2000 IU; vitamin D, 200 IU; vitamin E, 3 IU; vitamin K, 1.2 mg; riboflavin, 1.5 mg; pantothenic acid, 6 mg; niacin, 9.6 mg; choline, 30 mg; vitamin B_{12}, 6 mcg; selenium, .05 mg; penicillin, 25 mg; aureomycin, 50 mg and sulfamethazine, 50 milligrams.

Results

A summary of the performance of the pigs is shown in table 2. No differences in average daily gain or feed per gain were observed. The average gain of 1.00 pound per day and feed/gain ratio of 2.41 are normal for this weight of pigs. Temperatures during the test were 45° F for a mean high and 24° F for a mean low. Although the pigs were under considerable stress from mixing pigs from two sources and being housed in open-front housing, no improvements in performance were observed when "Zinpro-40" was added to the diet.

TABLE 2. EFFECT OF "ZINPRO-40" SUPPLEMENTATION OF PIG STARTER DIETS (33 DAYS)

Starting weight, lb[a]	Control	"Zinpro-40"[b]
	Average Daily Gain, Lb	
25.6	1.09	1.13
24.0	.99	1.01
22.4	1.04	.91
21.2	1.03	1.15
19.2	.99	.93
18.0	.82	.88
Avg 21.7	.99	1.00
	Feed Per Gain	
25.6	2.44	2.46
24.0	2.56	2.49
22.4	2.38	2.56
21.2	2.45	2.23
19.2	2.19	2.24
18.0	2.51	2.39
Avg 21.7	2.42	2.40

[a] Eight pigs per pen.
[b] Contained 2 pounds of "Zinpro-40" per ton (90 ppm zinc).

Summary

Ninety-six pigs averaging 22 pounds were used to compare a basal starter diet containing 25 ppm of supplemental zinc with the basal diet plus 2 pounds per ton of "Zinpro-40," which gave a diet containing 115 ppm of added zinc. The pigs were mixed from two sources and housed in open-front housing to create a stress situation. Over the 33-day trial, no differences in average daily gain or feed per gain were observed. No improvements were observed from adding "Zinpro-40" to the starter pigs' diet.

Effect of Distillers Dried Grains With Solubles in Pig Starter Diets

Richard C. Wahlstrom and George W. Libal

SWINE 80-6

During the past year there has been renewed interest in the feeding value of by-products of alcohol production. Previous research has dealt primarily with feeding of distillers dried grains or distillers dried grains with solubles (DDG/S). Research conducted at South Dakota State University had shown that growing-finishing pigs could be fed diets containing as much as 20% DDG/S without significantly affecting rate of gain. However, feed conversion was significantly poorer with this level of DDG/S in the diet. Protein and dry matter digestibility were also reduced when diets contained 20% of DDG/S.

The experiment reported herein was conducted to evaluate different levels of DDG/S in pig starter diets that were equalized in lysine content.

Experimental Procedure

Two trials were conducted with 120 crossbred pigs in each trial. Pigs were weaned at an average age of approximately 4 weeks and placed on the experimental diets. Pigs averaged 17.8 pounds initially. Six replicated lots were assigned to each of four treatments in each trial. The pigs were housed in the swine laboratory room in the Animal Science Complex and continued on experiment for 4 weeks.

The dietary treatments were as follows:

1. Basal diet, 0% distillers dried grains with solubles (DDG/S)
2. 10% DDG/S
3. 20% DDG/S
4. 30% DDG/S

The basal corn-soybean meal diet was formulated to contain 19.6% crude protein and 1.05% lysine. The diets containing DDG/S were formulated to contain the same amount of protein and lysine as the basal diet by altering the ratio of corn and soybean meal and supplementing with synthetic L-lysine monohydrochloride. The composition of the experimental diets is shown in table 1.

Results

The data for both trials were combined and are presented in table 2. There was a significant difference in average daily gain among treatments. Daily gains decreased in a linear fashion as the level of DDG/S in the diet was increased. Pigs fed diets of 0, 10, 20 or 30% DDG/S gained .77, .74, .70 and .65 pound per day, respectively. There were no statistically significant differences among treatments in average daily feed consumption or in feed

TABLE 1. COMPOSITION OF DIETS (PERCENT)

Ingredients	Distillers dried grains/solubles (%) 0	10	20	30
Corn, 8.8% crude protein	65.4	60.5	55.6	50.8
Soybean meal, 43.5% crude protein	31.9	26.8	21.7	16.6
DDG/S, 26.5% crude protein	—	10.0	20.0	30.0
Dicalcium phosphate	1.2	.9	.7	.4
Ground limestone	.9	1.08	1.16	1.24
Trace mineral salt	.3	.3	.3	.3
Premix[a]	.3	.3	.3	.3
L-lysine monohydrochloride	—	.12	.24	.36
Chemical analysis				
Crude protein, %	19.85	19.75	21.05	20.06
Lysine, %	1.20	1.16	1.23	1.16

[a] Supplied per pound of diet: vitamin A, 2000 IU; vitamin D, 200 IU; vitamin E, 3 IU; vitamin K, 1.2 mg; riboflavin, 1.5 mg; pantothenic acid, 6 mg; niacin, 9.6 mg; choline, 30 mg; vitamin B_{12}, 6 mcg; selenium, .05 mg; penicillin, 25 mg; aureomycin, 50 mg and sulfamethazine, 50 milligrams.

TABLE 2. DISTILLERS DRIED GRAINS WITH SOLUBLES IN YOUNG PIG DIETS

	Distillers dried grains/solubles (%) 0	10	20	30
Avg initial wt, lb[a]	17.8	17.8	17.7	17.7
Avg final wt, lb[b]	39.4	38.3	37.3	35.9
Avg daily gain, lb[c]	.77	.74	.70	.65
Avg daily feed, lb	1.34	1.34	1.28	1.23
Feed/gain	1.75	1.82	1.84	1.90

[a] Twelve lots of five pigs each per treatment.
[b] Significant difference among treatments ($P<.05$).
[c] Significant difference among treatments ($P<.01$).

required per unit of gain. However, less of the diets containing 20 and 30% DDG/S was consumed compared to the diets of 0 or 10% DDG/S. Also, the trend was for more feed/gain as the level of DDG/S in the diet increased.

Summary

Two hundred forty young weaned pigs of an average weight of 17.8 pounds were used in two trials to study the effect of 0, 10, 20 or 30% distillers dried grains with solubles in diets fed for 4 weeks. Diets were equalized in lysine content at a level above the suggested requirement for pigs of this size.

Average daily gains were significantly decreased as dietary level of DDG/S increased. Feed consumption and feed efficiency decreased with increasing levels of DDG/S. However, the differences were not significant. The data indicate that the young pig can utilize this by-product, but it appeared to affect palatability and the higher fiber content may have been involved in the reduced gains and increased feed/gain.

The Influence of Frame Size on Growth and Carcass Characteristics of Swine Taken to Heavy Weights

W. Vanderwert, George W. Libal, Dan H. Gee, and Richard C. Wahlstrom

SWINE 80-7

Despite over two decades of selection for leaner hogs, excess fat remains a major problem in market swine today. Fat is an expensive product to produce and research clearly indicates that feed/gain increases when an animal's bone and muscle growth decreases and deposition of fat increases.

In recent years progressive swine producers have sought a larger framed hog that matures at a heavier weight. In theory, these large framed pigs are leaner and maintain desirable feed/gain to heavier weights and therefore offer the flexibility to be marketed at heavier weights if favorable marketing conditions prevail.

The study reported herein was designed to evaluate large and small framed pigs for growth and carcass characteristics when taken to a 300-pound slaughter weight.

Experimental Procedure

Five trials involving 120 head of crossbred hogs were conducted in this experiment. A total of 80 head, 49 barrows and 31 gilts, were slaughtered and complete carcass data obtained. An additional 32 gilts were fed for gain and feed efficiency data before entering the breeding herd. Eight head were removed from the test for a variety of reasons.

A majority of the pigs used in this study were from the South Dakota State University swine herd which consists of three-way crossbred hogs involving Durocs, Hampshires and Yorkshires. Pigs from an outside source which were Chester White sired were used in one phase of the study to sample a population outside of the South Dakota State University herd.

At the beginning of each trial, pigs of the desired weight were sorted for frame size by visual appraisal. Small framed pigs can be described as those pigs which were lower set, shorter legged, shorter bodied and wide through the thoracic region in relation to their depth of body. These pigs were selected to fit an early maturing model. Large framed pigs, on the other hand, were taller, longer legged and bodied and deep in relation to their width of body in the thoracic region.

Pigs selected were at the extremes of the normal distribution of frame size, representing approximately the upper and lower 15% of the South Dakota State University swine herd. However, they did not represent extremes in the swine population today as the small framed pigs had near industry average backfat measurements at slaughter (industry average figures based on a much lighter slaughter weight).

Trials differed in starting weight. The first three trials concentrated on selecting pigs of market weight and trials 4 and 5 were initiated with lighter weight pigs. An intermediate frame group was also selected in trial 5. All pigs were fed within sex and treatment groups and received a standard finishing diet. All trials were conducted in a fully slatted, controlled environment barn.

Results

Feed/gain and average daily feed data for all trials combined are presented in table 1. Feed/gain follows a trend with the large framed pigs the most efficient in feed conversion. Analysis of variance for feed/gain indicated that these treatment differences approached significance (P=.15). Average daily feed did not follow a trend, although the large framed pigs had the largest appetites.

TABLE 1. FEED/GAIN AND AVERAGE DAILY FEED
(220 LB TO END OF ALL TRIALS)

	Treatment			Sex	
	Large framed	Intermediate framed	Small framed	Barrows	Gilts
Feed/gain	4.51	4.70	5.13	4.98	4.58
Avg daily feed, lb	6.47	5.96	6.24	6.16	6.28

Trial 1 results are presented in table 2. Small framed pigs outgained the large framed pigs, although not significantly. Barrows gained significantly faster than gilts. Gilts were not slaughtered in this trial and carcass data show a significant advantage to large framed barrows in carcass meatiness traits. Carcasses of large framed pigs had 23% larger loin eye areas, 36% less tenth rib backfat, were 4.5% longer, had 14% more lean and 15% more lean in ham and loin than carcasses of small framed pigs.

TABLE 2. PERFORMANCE AND CARCASS CHARACTERISTICS, TRIAL 1
(GILTS AND BARROWS)

	Large framed	Small framed	Barrows	Gilts
Initial weight, lb	217.69	218.06	220.50	215.25
Final weight, lb	282.56	286.63	293.25*	275.94
Avg daily gain, entire test, lb	1.54	1.63	1.73*	1.45
Carcass weight, lb	216.13	223.8		
Loin eye area, sq. in.	5.34**	4.35		
Tenth rib backfat, in.	1.22**	1.92		
Carcass length, in.	34.29**	32.81		
Percent lean (formula determined)	52.41**	46.02		
Percent lean in ham and loin (actual)	56.65**	49.13		

* P<.05.
** P<.01.

The results of an all-gilt trial, the second in this experiment, are presented in table 3. Large framed gilts gained significantly faster than the small framed treatment group. In addition, they were leaner, longer and possessed a higher percent lean in the ham and loin from actual cutout.

TABLE 3. PERFORMANCE AND CARCASS CHARACTERISTICS, TRIAL 2 (GILTS)

	Large framed	Small framed
Initial weight, lb	232.12	232.75
Final weight, lb	300.62	292.40
Avg daily gain, entire test, lb	1.58**	.95
Carcass weight, lb	229.25	227.00
Loin eye area, sq. in.	6.04	6.05
Tenth rib backfat, in.	1.18*	1.49
Carcass length, in.	33.84**	32.08
Percent lean (formula)	53.68	51.82
Percent lean in ham and loin	59.00*	55.46

* P<.05.
** P<.01.

Trial 3 results appear in table 4. As in trial 2, the large framed pigs outgained their small framed counterparts and, surprisingly, gilts outgained barrows. Evidence of their lateness of maturity was shown for large framed barrows which were superior in carcass leanness traits, although not significantly in all cases.

TABLE 4. PERFORMANCE AND CARCASS CHARACTERISTICS, TRIAL 3 (BARROWS AND GILTS)

	Large framed	Small framed	Barrows	Gilts
Initial weight, lb	239.81	239.56	245.06*	234.31
Final weight, lb	299.94	288.69	295.38	293.25
Avg daily gain, entire test, lb	1.56*	1.28	1.30	1.54
Carcass weight, lb	227.12	224.62		
Loin eye area, sq. in.	5.30	5.33		
Tenth rib backfat, in.	1.21*	1.42		
Carcass length, in.	34.08**	33.69		
Percent lean (formula)	51.68	50.88		
Percent lean in ham and loin	54.43	53.59		

* P<.05.
** P<.01.

Gilts and barrows were slaughtered in trial 4 and performance and carcass data are shown in table 5. Consistent with other trials, large framed pigs gained faster and were leaner than small framed pigs. Barrows had a slight advantage over gilts in gain and, surprisingly, had less tenth rib backfat. Gilts had a significant advantage in loin eye area.

TABLE 5. PERFORMANCE AND CARCASS CHARACTERISTICS, TRIAL 4 (BARROWS AND GILTS)

	Large framed	Small framed	Barrows	Gilts
Initial weight, lb	161.62	159.25	161.88	159.00
Final weight, lb	287.50	284.88	292.00	280.38[a]
Avg daily gain, 160 to 220 lb, lb	1.90*	1.43	1.68	1.64
Avg daily gain, 220 lb to end, lb	1.28	1.05	1.22	1.12
Carcass weight, lb	223.04	221.71	221.25	223.50
Loin eye area, sq. in.	5.73	5.61	5.17	6.17**
Tenth rib backfat, in.	1.02	1.20	1.07	1.14
Carcass length, in.	34.35	33.66	34.25	33.76
Percent lean (formula)	53.82	52.57	52.26	54.13
Percent lean in ham and loin	57.58	56.51	57.95	56.14

[a] Contains data on two gilts not slaughtered.
* $P<.05$.
** $P<.01$.

An intermediate framed group was added to trial 5 which was initiated with lighter weight pigs. Accuracy of visual selection for frame size was evident in that leanness and length traits followed expected trends (table 6). There was no difference in average daily gains among treatment groups in this trial, although gilts had a slight advantage in this trait. Gilts were also longer, leaner and had larger loin eyes than barrows.

Summary

One hundred twenty crossbred pigs were used to evaluate growth and carcass characteristics of pigs of varying frame sizes. Growth rate beyond 220 pounds was of primary interest and favored the large framed pigs in three of five trials. However, gains of pigs decreased at heavier weights and, in general, could be considered as unsatisfactory regardless of frame size. Feed/gain data from all trials combined showed large framed pigs to be the most efficient.

Carcasses of large framed pigs were consistently longer, had less backfat and a higher percent lean than carcasses of small framed pigs.

TABLE 6. PERFORMANCE AND CARCASS CHARACTERISTICS, TRIAL 5 (BARROWS AND GILTS)

	Large framed	Inter-mediate framed	Small framed	Barrows	Gilts
Initial weight, lb	113.92	116.42	115.63	115.22	115.42
Final weight, lb	295.46	298.58	297.46	295.33	299.00
Avg daily gain, 115 to 160 lb, lb	1.82	1.58	1.81	1.69	1.78
Avg daily gain, 160 to 220 lb, lb	1.59	1.71	1.51	1.60	1.60
Avg daily gain, 220 lb to end, lb	1.22	1.28	1.24	1.14	1.35
Carcass weight, lb	225.25	229.71	225.00[a]	230.22	223.08[a]
Loin eye area, sq. in.	5.64	5.88	5.36	5.53	5.72
Tenth rib backfat, in.	1.18	1.37	1.61	1.50	1.26
Carcass length, in.	34.13	33.62	33.26	33.23	34.11*
Percent lean (formula)	52.71	52.30	49.90	50.87	52.41
Percent lean, ham and loin	58.23	58.12	54.62	55.20	58.79

[a] Carcass weight data includes one animal which was skinned.

* $P<.05$.

Effect of Feeding Ground Sunflower Seeds to Gestating and Lactating Sows

Mark A. Kepler, George W. Libal, and Richard C. Wahlstrom

SWINE 80-8

Sunflowers are fast becoming a major agricultural crop in South Dakota and research on their usefulness as a feed ingredient in swine diets has been limited. The high fat content of some sunflowers (approximately 40%) lends itself as a possible source of fat in the diets of late gestating and early lactating sows. Recent research at other universities has indicated that fat addition to the diet of sows during late gestation will increase piglet survivability by increasing the amount of energy stored in the piglet body at birth, thus making them less vulnerable to starvation and sow overlay. This fat addition may also increase the fat content of the colostrum milk serving as an additional energy source to the young pig.

The objective of this experiment was to determine the value of whole sunflower seeds as a part of the sow diet in late gestation and early lactation and its effect on piglet survivability.

Experimental Procedure

Three trials were conducted using a total of 44 sows and 55 gilts of Hampshire x Yorkshire x Duroc breeding. Sows and gilts were allotted on the basis of weight and sire breed to three treatment groups fed diets of 0, 25 and 50% whole sunflower seeds. Diets were fed at a level of 5 pounds per day beginning on day 100 of gestation until farrowing. Feed was provided *ad libitum* during lactation. On day 110 of gestation, sows and gilts were moved to the farrowing house and allotted into individual crates or conventional farrowing pens. Table 1 shows the composition of the diets.

In trial 1, one male and one female piglet were selected from each litter at the time of farrowing and, in trials 2 and 3, four piglets were selected at random, disregarding sex, and bled within 1 minute following birth. These pigs were then rebled at 24 hours of age. The blood samples were analyzed for plasma glucose level.

Following birth, all baby pigs were weighed, needle teeth clipped, tails docked, iodine placed on naval cords, ears notched and they received an injection of iron and an antibiotic. Piglets were reweighed at 14 days of age. Survival was calculated as a percent of those pigs born alive surviving to 14 days.

Sows were weighed at day 110 of gestation, after farrowing and on day 14 of lactation. Daily feed consumption of sows during lactation was recorded. Milk samples were taken from each sow during farrowing and at 1 week and 2 weeks following farrowing for fat analysis.

TABLE 1. COMPOSITION OF DIETS (%)

Ingredients	Sunflower seeds, % 0	25	50
Ground yellow corn	84.50	65.58	46.51
Ground sunflower seeds	0	25.0	50.0
Soybean meal, 44%	11.85	5.85	0
Dicalcium phosphate	2.27	1.89	1.54
Ground limestone	.75	.87	.97
Lysine	.03	.21	.38
Trace mineral salt[a]	.40	.40	.40
Vitamin-antibiotic mix[b]	.2	.2	.2
Chemical analysis[c]			
Fat	3.1	13.0	21.2
Protein	14.3	13.9	13.8
Fiber	2.6	6.0	8.6
Lysine	.59	.52	.51

[a] .8% zinc.

[b] Supplied per pound of diet: vitamin A, 2000 IU; vitamin D, 200 IU; vitamin E, 2.5 mg; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 8 mg; choline, 25 mg; vitamin B_{12}, 5 mcg and aureomycin, 50 mg (trial 1); neomycin, 75 mg, and oxytetracycline, 75 mg (trials 2 and 3).

[c] Average of three separate samples of all diets.

Results

The results of this experiment are summarized in tables 2 and 3. Table 2 shows the results obtained from the prefarrowing and lactation treatments. Nine sows experienced severe mastitis and were not included in the 14-day data. Three sows allotted to the 50% diet refused to eat this diet and were removed from the experiment prior to farrowing.

Significant differences were observed for percent milk fat in the 25 and 50% sunflower groups at 1 week and 2 weeks of lactation as compared to the control group. Higher milk fat observed for these two groups reflects the higher percent fat in those diets. The higher energy present in the milk did not result in higher piglet gain to 14 days or heavier 14-day weights. One hundred ten-day gestation, post-farrowing and 14-day lactation sow weights and litter birth weights were all significantly higher for sows than gilts, but no dietary differences were observed for these values. There were no significant differences observed in any of the other criteria measured. Similar survival rates were observed between treatment groups.

Table 3 shows the effects of the sunflower addition to the gestation diet on the pigs born from these sows. No significant differences were observed for birth and 24-hour plasma glucose. Any differences in birth weight reflect only the random choice of pigs bled.

TABLE 2. EFFECT OF SUNFLOWER SEEDS IN GESTATION AND LACTATION DIETS ON SOW AND PIG PERFORMANCE[a]

	Sunflower seeds, %		
	0	25	50
Number farrowing[b]	35	31	30
Avg sow gestation wt. (110 days), lb	503	497	489
Avg sow post-farrowing wt., lb	464	461	451
Avg sow lactation wt. (14 days), lb	463	448	440
Avg sow lactation wt. gain (14 days), lb	49	42	46
Avg sow lactation feed consumed per day, lb	8.80	8.55	8.54
Avg number live pigs born	9.77	10.09	9.33
Avg number pigs, 14 days	7.09	7.36	6.49
Percent survival	72.57	72.94	69.60
Avg number stillborn pigs	1.00	.85	.85
Avg litter birth wt., lb	30.85	31.15	29.87
Avg pig birth wt., lb	3.21	3.11	3.25
Avg litter wt. (14 days), lb	56.78	59.61	51.19
Avg pig wt. (14 days), lb	8.03	8.00	8.30
Avg litter gain (14 days), lb	33.12	35.91	29.48
Avg pig gain (14 days), lb	4.71	4.80	4.75
Avg colostrum milk fat, %	5.38	6.41	6.61
Avg milk fat (1 week), %[c]	7.83	10.09	11.42
Avg milk fat (2 weeks), %[c]	7.61	9.42	11.72

[a] Three trials with farrowings in March-April, June-July and August-September, respectively.
[b] Nine sows were removed after farrowing due to illness.
[c] Significant difference due to sunflower addition (P<.05).

TABLE 3. EFFECT OF SUNFLOWER DIET ON BLOOD GLUCOSE

	Sunflower seeds, %		
	0	25	50
Number of piglets[a]	115	96	106
Avg birth wt., lb	3.25	3.32	3.34
Avg birth plasma glucose, mg/100 ml	93.5	93.1	90.2
Avg 24-hour plasma glucose, mg/100 ml[b]	83.6	84.6	78.9
Avg 14-day wt., lb	8.03	8.29	7.54

[a] Trial 1 - 2 pigs per sow, Trial 2 - an attempt was made to get 4 pigs per sow and Trial 3 - 4 pigs per sow.
[b] Not all pigs bled at birth survived to 24 hours.

In this experiment, no advantage was seen from the addition of sunflower seeds to the diet of late gestating and early lactating swine, with the possible exception of the additional fat found in the milk. Although not proving beneficial in this experiment, this needs to be investigated further. It should be noted that no disadvantage was seen to adding sunflower seeds to the diet of sows to replace part of the protein and energy of the feed. This may be a method by which swine producers are able to feed out sunflower seeds they are unable to sell that may have been damaged or are immature. A chemical analysis should be performed on these seeds before using. The diet of 50% sunflowers was unpalatable to some sows in this study. Thus, the maximum level of sunflowers used in sow diets appears to be somewhere between 25 and 50% of the diet.

Summary

Three trials involving a total of 96 sows and gilts were conducted to study the effects of 25 and 50% sunflower diets during late gestation and early lactation. The sunflower addition resulted in a significant increase in fat content of the milk at 1 week and 2 weeks of lactation. No other significant differences were seen. Birth weight, 14-day weight and 14-day weight gain of pigs, lactation weight gain and lactation feed consumption of sows and piglet survival were all similar among treatments.

Three hundred seventeen pigs from these sows that were bled at birth and 24 hours of age showed similar plasma glucose levels. Addition of up to 50% sunflower seeds had no advantage or disadvantage to the diet of late gestating or early lactating swine.

Effects of Antibiotics and Floor Types on Weaned Pig Performance

George W. Libal, Mark A. Kepler, Kee Nahm, and Richard C. Wahlstrom

Proper environment for young pigs after early weaning and the most desirable floor type for maximum performance of the young pig have not been established. The effectiveness of antibiotics under ideal conditions has been the subject of considerable discussion. The relationship between floor type and pig response to antibiotics at this stage of growth is still unclear. The four trials reported herein were designed to evaluate the effect of antibiotics on pig performance under controlled conditions, to evaluate the effect of several different types of floors on pig performance and, in one trial, to look at the interaction between antibiotics and floor types as measured by pig performance.

Experimental Procedure

Four trials were conducted during the past year to evaluate weanling pig response to different floor types and to the addition of Aureo SP-250 to their diets. In all trials, pigs were allotted to treatments on the basis of weight and ancestry at an average age of 4 weeks. The trials were conducted for either 4 or 5 weeks. The pigs were housed in the environmentally controlled swine room in the Animal Science Complex. Temperature was maintained at approximately 80° F at the beginning of the trials and was dropped to 75° near the end of the trials.

Trial 1

A 4-week study was conducted to evaluate pig response to 0 or 250 grams per ton of Aureo SP-250 added to an 18% protein starter diet. A total of 96 pigs averaging 16.7 pounds were allotted to 12 replications of the two treatments with four pigs per pen. The pens were concrete floored with steel mesh across a gutter in one end of the pen.

Trial 2

The antibiotic treatments of trial 1 were repeated in trial 2. In addition, pigs were placed in pens with either concrete floors as described in trial 1 or raised floors with plastic ("FILTER-EEZE") flooring. Ninety-six pigs averaging 19.0 pounds starting weight were allotted to six replications of the treatments which included the two floor types and 0 or 250 grams per ton additions of Aureo SP-250. The trial lasted 5 weeks.

Trial 3

Comparison of performance of pigs on concrete or plastic floors was the purpose of this 4-week trial. A total of 120 pigs, average weight of 18.3 pounds, were allotted to the 12 replications of the treatments with five pigs per pen. Several diets were fed to the pigs during the 4-week trial, but these were equalized across treatment to accurately evaluate performance due to floor type.

Trial 4

Performance of pigs placed on plastic floors and a vinyl coated, expanded metal flooring (SANI-DECK) was compared in this 4-week study. Twelve replications with five pigs per pen resulted in the allotment of 120 total pigs averaging 17.2 pounds. As in trial 3, several diets were used and they were equalized across the two floor treatments.

Results and Discussion

Trial 1

A summary of pig performance in this 4-week study is shown in table 1. No advantage was obtained from the addition of 250 grams of Aureo SP-250 to the pigs' diet. In fact, the controls actually performed better than the treated pigs. Pigs were continued on these diets to an average pig weight of 75 pounds. At that time performance was essentially equal between the two groups.

TABLE 1. PIG PERFORMANCE IN TRIAL 1[a]

Aureo SP-250, g/ton	0	250
Initial pig weight, lb	16.6	16.7
4-week pig weight, lb	31.3	28.7
Average daily gain, lb	.54	.43
Average daily feed, lb	1.11	.95
Feed/gain[b]	2.03	2.26

[a] Ninety-six pigs, 4 pigs per pen, 12 replications.
[b] $P<.05$.

Trial 2

Data from trial 2 were analyzed as a 2 x 2 factorial arrangement of 0 and 250 grams per ton of Aureo SP-250 and either concrete or raised plastic (FILTER-EEZE) floors. Tables 2 and 3, respectively, show the effect of floor type averaged across antibiotic level and the effect of antibiotics averaged across floor type.

The floor type had a significant effect on pig gain, daily feed consumption and efficiency of gain. Pigs on the raised plastic flooring gained faster ($P<.05$), consumed more feed daily ($P<.01$) and converted feed to gain more efficiently ($P<.05$) than pigs on the solid floor.

Pigs receiving Aureo SP-250 gained faster and consumed more feed than pigs on the control diet. They also tended to be more efficient, although this difference was not significant.

TABLE 2. EFFECT OF FLOOR TYPE ON PIG PERFORMANCE (TRIAL 2)

Floor type	Concrete	Plastic
Initial pig weight, lb	18.9	19.0
5-week pig weight, lb[a]	39.0	43.2
Average daily gain, lb[a]	.57	.68
Average daily feed, lb[b]	1.62	1.76
Feed/gain[a]	2.92	2.58

[a] $P<.05$.
[b] $P<.01$.

TABLE 3. EFFECT OF ANTIBIOTICS ON PIG PERFORMANCE (TRIAL 2)

Aureo SP-250, g/ton	0	250
Initial pig weight, lb	18.9	18.9
4-week pig weight, lb[b]	37.8	44.5
Average daily gain, lb[b]	.53	.73
Average daily feed, lb[a]	1.54	1.84
Feed/gain	2.94	2.56

[a] $P<.05$.
[b] $P<.01$.

The combined effects of floor type and antibiotic in trial 2 are shown in table 4. The best performance was obtained with pigs receiving antibiotic which were penned on the plastic floors. Performance of pigs penned on plastic floors and fed diets without antibiotics approached the performance level of pigs penned on concrete and fed diets containing antibiotic. The poorest performance was observed with pigs receiving no antibiotic in their diet and penned on concrete.

TABLE 4. COMBINED EFFECTS OF ANTIBIOTICS AND FLOOR TYPE TREATMENTS (TRIAL 2)[a]

Aureo SP-250, g/ton	0		250	
Floor type	Concrete	Plastic	Concrete	Plastic
Initial pig weight, lb	19.0	18.9	18.9	19.0
5-week pig weight, lb	35.7	39.9	42.4	46.6
Average daily gain, lb	.48	.59	.68	.79
Average daily feed, lb	1.52	1.58	1.76	1.96
Feed/gain	3.20	2.68	2.64	2.49

[a] Ninety-six pigs, four pigs per pen, six replications.

Trial 3

The results of trial 3 are shown in table 5. Unlike the previous trial, no differences were seen in average daily gain, daily feed and feed/gain when pigs were kept in pens with concrete or plastic floors.

TABLE 5. EFFECT OF FLOOR TYPE ON PIG PERFORMANCE[a]

Floor type	Concrete	Plastic
Initial weight, lb	18.3	18.3
4-week weight, lb	38.9	39.1
Average daily gain, lb	.73	.74
Average daily feed, lb	1.33	1.28
Feed/gain	1.83	1.75

[a] One hundred twenty pigs, five pigs per pen, 12 replications.

Trial 4

Table 6 shows a summary of pig performance on the two floor types used in trial 4. Pigs grown on the vinyl coated, expanded metal floors (SANI-DECK) gained significantly faster than those grown on the plastic (FILTER-EEZE) floors. Pigs housed on the vinyl coated, expanded metal floors also tended to consume more feed and were slightly more efficient, although these differences were not significant.

TABLE 6. EFFECT OF FLOOR TYPE ON PIG PERFORMANCE[a]

Floor type	Vinyl coated expanded metal	Plastic
Initial pig weight, lb	17.2	17.1
4-week pig weight, lb[b]	37.5	35.2
Average daily gain, lb[b]	.73	.65
Average daily feed, lb	1.32	1.23
Feed/gain	1.85	1.89

[a] One hundred twenty pigs, five pigs per pen, 12 replications.
[b] $P<.05$.

Summary

Five trials were conducted with 432 4-week-old pigs to evaluate the use of Aureo SP-250 and to test several floor types in nursery pens. In the two trials which compared Aureo SP-250 at 0 and 250 grams per ton, pigs responded to the antibiotics with higher gains and better feed efficiency in one trial and exhibited no response to the antibiotics in the other. Two trials compared concrete floored pens with raised plastic floored pens (FILTER-EEZE). In one trial, pigs performed significantly better on the plastic flooring and in the other trial no differences were observed. A final trial compared performance of pigs on plastic flooring with pigs on a vinyl coated expanded metal flooring (SANI-DECK). Significantly faster gain was observed with the use of the vinyl coated expanded metal flooring.

TABLE 2. SOW AND PIG PERFORMANCE AS AFFECTED BY TREATMENTS

	Control	XLP-30	Neo-Terra
No. of gilts	12	9	11
No. of sows	16	15	17
	Sow Weight, Lb		
110 days	469	480	475
After farrowing	444	452	445
21 days	439	420	437
	Birth		
Avg no. of live pigs	7.80	8.08	8.26
Avg no. of stillborn	.65	1.80	1.08
Avg. pig weight, lb	2.97	2.90	3.04
Avg litter weight, lb	22.9	23.5	25.1
	10 Days		
Avg no. of live pigs	5.43	5.06	6.09
Avg pig weight, lb	6.03	6.34	6.40
Avg litter weight, lb	37.8	36.7	42.5
	21 Days		
Avg no. of live pigs	5.21	4.87	6.06
Avg pig weight, lb	11.33	11.24	11.57
Avg litter weight, lb	67.5	62.3	74.6
Percent survival	66.8	62.6	73.4

Effects of Housing and Pen Space on Performance of Growing-Finishing Pigs

Richard C. Wahlstrom and George W. Libal

SWINE 80-11

In several previous experiments conducted by the authors, we have found that pigs housed in open-front buildings with access to an outside concrete feeding floor gained faster than pigs in an enclosed confinement building. The reasons for this difference are associated with increased feed consumption, but the causes of increased feed intake are not clear.

The experiment reported herein was conducted to obtain information on the effect of increasing pen space during the finishing period and also the effect of movement of pigs from inside to outside type housing with additional pen space during the finishing period.

Experimental Procedure

Sixty-four crossbred pigs averaging about 60 pounds were allotted to four treatment groups with four pens per treatment and four pigs per pen (three gilts and one barrow). The four treatments were:

Treatment 1 - Enclosed building with 7.1 square feet of pen space per pig from 60 to 140 pounds and 14.2 square feet from 140 to 220 pounds
Treatment 2 - As treatment 1 to 140 pounds; moved at 140 pounds to open-front building having 12 square feet of sleeping area and 16 square feet of outside area per pig
Treatment 3 - Enclosed building with 7.1 square feet of pen space per pig from 60 to 220 pounds
Treatment 4 - Open-front building with 12 square feet of sleeping area and 16 square feet of outside area per pig from 60 to 220 pounds.

The enclosed building was an insulated, ventilated building with totally slatted floors. The open-front buildings were uninsulated wooden houses (8 x 12) that were divided in the center to make two inside pens 8 x 6 feet. Each pen had an outside concrete area (6 x 12 feet) where feeders and waterers were located. All pigs were fed a 14% protein corn-soybean meal fortified diet for the entire experiment. The experiment was conducted from late April to late August.

Results

The average daily gain, daily feed consumption and feed/gain data for the different treatments are shown in table 1. There were no significant differences in any period among treatments. During the finishing phase from 140 to 220 pounds, pigs in the enclosed building that were given double pen

TABLE 1. RESULTS OF HOUSING MANAGEMENT SYSTEMS[a]

Housing and space/pig (sq ft) 60-140 lb	Enclosed 7.1	Enclosed 7.1	Enclosed 7.1	Open-front 12-16[b]
Housing and space/pig (sq ft) 140-220 lb	Enclosed 7.1	Enclosed 14.2	Open-front 12-16[b]	Open-front 12-16[b]
Avg initial wt, lb	60.4	61.5	60.6	60.3
Avg wt at change, lb	142.5	136.0	141.6	136.6
Avg final wt, lb	226.3	224.3	225.1	229.0
Avg daily gain, lb				
60-140 lb[c]	1.42	1.32	1.39	1.31
140-220 lb[c]	1.66	1.88	1.63	1.75
60-220 lb[d]	1.53	1.58	1.53	1.52
Avg daily feed, lb				
60-140 lb	4.25	4.13	4.05	4.37
140-220 lb	5.49	5.53	6.14	6.17
60-220 lb	4.83	4.81	5.03	5.21
Feed/gain, lb				
60-140 lb	3.00	3.12	2.92	3.34
140-220 lb	3.33	2.93	3.63	3.53
60-220 lb	3.17	3.01	3.31	3.43

[a] Four replicates of four pigs each per treatment.
[b] Twelve square feet sleeping space and 16 square feet outside area per pig.
[c] Significant sex difference (P<.05).
[d] Significant sex difference (P<.01).

space gained 1.88 pounds per day compared to 1.66 pounds for those pigs in the more restricted space of 7.1 square feet per pig. Average daily feed consumption was greater for those pigs housed in the open-front buildings. However, since the rate of gain of these pigs was not improved, it resulted in more feed/gain being required when pigs were housed in the open-front buildings. Previous experiments had noted an increased feed consumption, but it was accompanied by an increased gain. Barrows gained significantly faster than gilts in all growth periods.

Summary

Sixty-four crossbred pigs were used in an experiment to study the effects of open-front and enclosed housing and additional pen space during the 140- to 220-pound period. There were no significant differences between housing types. Pigs housed in the enclosed building and given access to double pen space, 14.2 square feet per pig during the 140- to 220-pound period, gained 13% faster than pigs in the same building with 7.1 square feet of pen space. However, these differences were not statistically significant.

Feed Value of By-products of Alcohol Production for Swine

Richard C. Wahlstrom

The production of alcohol as a fuel energy source has created an interest in "on-the-farm" alcohol plants. Although many different materials can be used in the production of alcohol, most interest has centered on the use of corn as the carbohydrate source. In this process, the starch in corn is converted to sugar and the sugar to alcohol which is then distilled off leaving a liquid product of approximately 5 to 10% dry matter. This product is called "stillage" and it contains considerable amounts of nutrients.

It is generally considered that it is not economically feasible to dry this feed by-product because of the energy costs. This creates a problem in feeding material of this high-moisture content. However, it may be possible through the use of screens and filters to remove some of the water at a minimal cost. There have been reports of stillage having 20 to 25% dry matter by this method.

Each bushel of corn used in the distillation process will result in about 17 pounds of dry matter in the form of stillage. About 11 pounds of this dry matter are present in the wet grains and the other 6 pounds are present in the soluble material. The advantage of removing some of the water from the stillage is shown in table 1. By increasing the dry matter of the stillage from 7 to 25%, one would eliminate over 70% of the water. The mechanics of handling this lesser volume of material would be a definite advantage.

TABLE 1. STILLAGE FROM EACH BUSHEL OF CORN PROCESSED

Dry matter of stillage	Pounds of stillage per bushel of corn processed
7%	243
14%	122
25%	68

Feeding Stillage

Table 2 presents the average nutrient content of corn grain and distillers dried grains with solubles and also the predicted nutrient content of distillers wet grains and whole stillage. The nutrient content in stillage on a dry matter basis is approximately three times the level of the nutrients in corn except for energy. Therefore, on a dry matter basis, the protein content should be about

TABLE 2. NUTRIENT COMPOSITION OF CORN AND DISTILLERS BY-PRODUCTS

Nutrient, %	Corn grain[a]	Distillers dried grains/solubles[a]	Distillers wet grains[b]	Whole stillage[c]
Dry matter	89.0	93.0	30.0	7.0
Protein	8.8	27.2	8.8	2.1
Fat	3.8	9.0	2.6	.7
Fiber	2.2	9.1	2.8	.7
Ash	1.1	4.5	.6	.34
Calcium	.02	.15	.03	.01
Phosphorus	.28	.95	.12	.07
Lysine	.24	.60	.19	.05

[a] From National Research Council reports.
[b] Calculated from nutrient content of distillers dried grains.
[c] Calculated from nutrient content of distillers dried grains with solubles.

27 to 30%, fiber and fat about 9%, lysine .55 to .65%, phosphorus .95%, calcium .10 to .15% and it is a good source of many of the water soluble B vitamins. The low quality of protein, due to low levels of lysine and tryptophan, and high level of fiber in the stillage dry matter limits its usefulness in swine diets. Stillage should be used mainly as a substitute for corn and not as a protein substitute in swine diets. Although 1 pound of dry matter from stillage should contain 27 to 30% protein, it will only contain about .55 to .65% lysine. This is about the amount of lysine that is present in a 12 to 14% protein diet. It also has been reported that stillage may be unpalatable and feed consumption is reduced when stillage is fed. Because of these reasons, it is recommended that stillage be limited to from 15 to 20% of the total dry matter of the diet and should not be used for pigs under 100 pounds in weight. Another thumb rule that can be used is to feed 1 pound of dry matter from stillage per pig daily. One pound of dry matter daily would be from 20 to 15% of a daily diet of 5 to 7 pounds. Using the dry matter values listed in table 1, a pig would need to consume 14, 7 or 4 pounds of stillage daily to receive 1 pound of dry matter from stillage containing 7, 14 or 25% dry matter, respectively.

How To Feed

Although only limited research has been conducted on feeding stillage, it appears that the producer has two alternatives on methods of feeding. Stillage could be fed separately along with a balanced diet fed free-choice or the stillage could be mixed with the dry feed. An example of a swine diet containing 15% of its dry matter from distillers grains containing 25% dry matter is shown in table 3. The diet is formulated on a dry matter basis and also on an "as fed" basis. The moisture content of the stillage results in the mixed feed also being high in moisture. The "as fed" diet contains about 65% dry matter and 35% moisture. Thus, it could require special feeding equipment and possibly daily mixing to prevent heating or molding of the mixture.

Workers at Iowa have reported that stillage did not spoil when stored up to 1 week. However, this necessitates liquid storage facilities. It would seem more feasible to utilize the stillage as it is produced if a constant supply is available.

TABLE 3. SWINE DIET USING DISTILLERS GRAINS (25% DM) AS 15% OF DRY MATTER OF TOTAL DIET

	Dry matter basis	As fed[a]
Corn	688	500
Soybean meal, 44%[b]	134	96
Distillers grains (25% DM)	150	386
Dicalcium phosphate	10	6.5
Limestone	10	6.5
Trace mineral salt	3	2
Premix[c]	5	3
Total	1000	1000
Calculated content		
Lysine	.65	
Phosphorus	.60	
Calcium	.67	

[a] 65% dry matter.
[b] Commercial supplements could replace the soybean meal with proper adjustments for lysine, calcium and phosphorus.
[c] Vitamin-additive premix.

Ordinarily about 240 pounds of stillage results from each bushel of corn processed because of the water added during the process. If one follows the recommendation of 1 pound of dry matter per pig daily, each pig would need to consume 14 pounds of 7% dry matter stillage daily (assuming each bushel of corn processed results in 240 pounds of stillage containing 17 pounds of dry matter; thus, 240 ÷ 17 = 14). Therefore, 17 pigs would be needed to consume the stillage produced from each bushel of corn processed daily. If fed free-choice, it may be necessary to limit water consumption from other sources in order to obtain consumption of the stillage.

Stillage for Sows

If stillage is made from corn free of molds, it should be quite acceptable for gestating sows. However, if there are mycotoxins in the original corn, these will be present in the stillage and it should not be fed to sows. Lactating sows can be fed limited amounts of stillage if total energy consumption is not reduced.

Summary

The value of stillage for swine is limited because of the quality of protein and therefore it should be used in limited quantities (not over 20% of the dry matter of the diet) and the diet must be supplemented to insure adequate lysine. Each bushel of corn will produce about 240 pounds of stillage containing 17 pounds of dry matter. If facilities for handling and feeding stillage are available, it can be fed free-choice or it could be fed as a paste feed in a ratio of 1.5 to 2.0 pounds of stillage per pound of dry diet. If the moisture in the stillage can be reduced to about 75%, less than 30% as much stillage will have to be handled and it would be possible to mix this material with dry feed in limited quantities to form complete diets.

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